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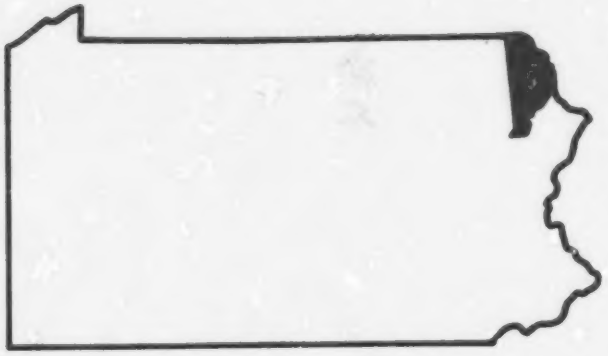
FLOOD INSURANCE STUDY

TOWNSHIP OF MANCHESTER, PENNSYLVANIA
WAYNE COUNTY



SEPTEMBER 30, 1988

COMPLETED

Federal Emergency Management Agency

COMMUNITY NUMBER - 422168

ORIGINAL

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

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FLOOD INSURANCE STUDY
TOWNSHIP OF MANCHESTER, WAYNE COUNTY, PENNSYLVANIA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Township of Manchester, Wayne County, Pennsylvania, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by the Philadelphia District, U. S. Army Corps of Engineers (COE), for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. EMW-85-E-1822, Project Order No. 1, Amendment No. 16. This study was completed in April 1987.

1.3 Coordination

A search for basic data was made at all levels of government. At an initial Consultation Coordination Officer's (CCO) meeting in December 1984 between representatives of FEMA and Manchester, study methods were agreed upon and sources of basic data were identified. Maps were supplied to the COE by community officials and the U. S. Geological Survey (USGS), which were used in the preparation of this study.

Final coordination between the community, FEMA, and the COE was accomplished through the final CCO meeting held in Manchester on December 1, 1987.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Township of Manchester, Wayne County, Pennsylvania. The area of study is shown on the Vicinity Map (Figure 1).

The Delaware River, from the downstream corporate limits to approximately 3.4 miles above Kellams Road; Little Equinunk Creek, from the confluence with the Delaware River to approximately 0.7 mile upstream of Stalker Road; and South Branch Equinunk Creek, from approximately 150' upstream of the confluence with Equinunk Creek to State Route 1018 would be studied by detailed methods. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction through April 1992.

The following flooding sources were studied by approximate methods: Cooley Creek, Little Equinunk Creek, the Delaware River, Price Pond, Equinunk Creek, and Crooked Creek. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and the Township of Manchester.

2.2 Community Description

The Township of Manchester is located in the northeastern corner of Wayne County. The historic Delaware River forms a natural boundary on the north and east stretches of Manchester, separating it from the State of New York. It is bordered by the Townships of Damascus and Lebanon to the south; and the Township of Buckingham to the west. The township covers an area of approximately 28,000 acres and had a 1980 population of 629. The forecasted population for the year 2000 is 671.

The first settlement in the Township of Manchester occurred during the 1770s and was located at Equinunk, which is in the northwestern section of the township. In August 1826, Manchester was formed from a portion of the Township of Buckingham. The population of the area steadily increased until the late 1800s, with farming being the main occupation. However, the Industrial Revolution of the late 19th and 20th century never dominated the area; therefore, the population has declined, and the area maintains its rural attributes. A 1986 land use summary indicates that the zoning for the township is predominantly agricultural and residential.

The topography of the area ranges from steep mountain peaks to gently rolling hills along with numerous lakes, ponds, and mountain streams, as well as several swamp areas. The Delaware River forms the northern and eastern boundary of the township and flows in a southeastern direction. Little Equinunk Creek flows in an eastern direction through relatively steep terrain to its confluence with the Delaware

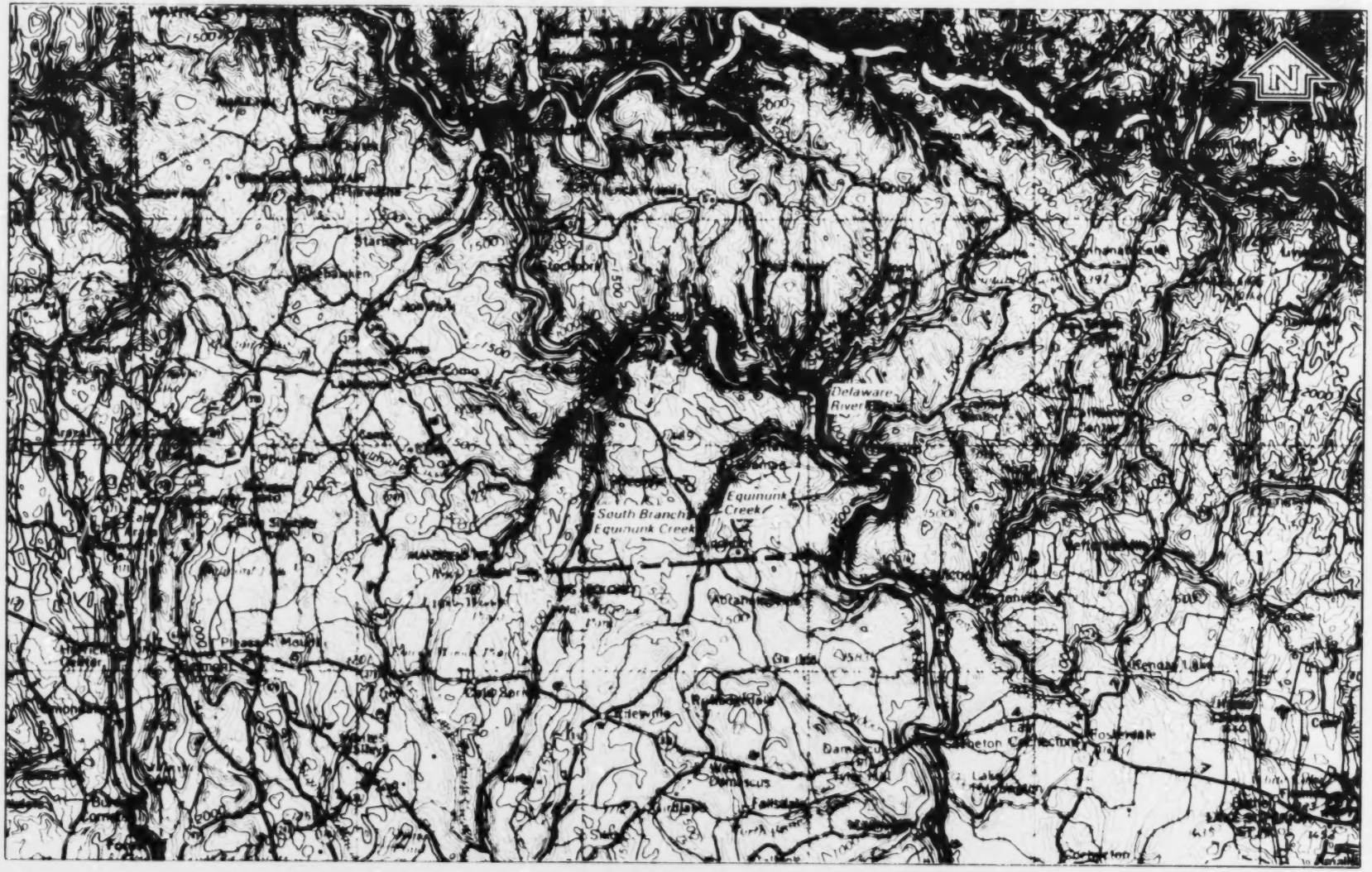


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF MANCHESTER, PA

(WAYNE CO.)

APPROXIMATE SCALE

4 0 4 8 12 MILES

VICINITY MAP

River. The South Branch Equinunk Creek flows in a northern direction through terrain that ranges from steep overbanks in the upstream sections, to broader and flatter floodplains near its confluence with Equinunk Creek.

The climate in this geographic area is characterized by temperatures ranging from an average high of 68°F in summer and 30°F in winter. The average annual rainfall for the region is 44 inches.

2.3 Principal Flood Problems

The principal flood problems in the Township of Manchester are associated with Little Equinunk Creek, South Branch Equinunk Creek, and the Delaware River. Most major floods have occurred during February, March, April, and May and are usually the result of spring rains and snowmelt. Floods during the summer months are often associated with tropical storms moving up the Atlantic coastline.

The largest flood on the Delaware River at the gages near Barryville (44 years of record) and at Port Jervis (80 years of record) occurred on August 19, 1955. This flood was the result of heavy rains from Hurricanes Connie and Diane, which passed over the Delaware River basin only a few days apart. Hurricane Connie passed over the basin first but did not directly cause any significant flooding. However, the rains from this hurricane saturated the soils in the basin so that when Hurricane Diane passed over the basin most of the rainfall became runoff.

2.4 Flood Protection Measures

New York City has several large water-supply reservoirs in the Delaware River basin. These reservoirs significantly retard floodwaters along the Delaware River even though they were not originally intended to be flood control structures. The Cannonsville Reservoir near Cannonsville, New York, and the Pepacton Reservoir near Downsville, New York, are two reservoirs that have helped reduce flooding along the Delaware River since their construction in 1963 and 1954, respectively.

There are no local flood protection measures along Little Equinunk Creek or the South Branch Equinunk Creek. Residents of Manchester depend on the usual warnings issued through radio, television, and local newspapers for information concerning possible flood conditions. Flood warnings and predicted flood peaks are issued by the National Oceanic and Atmospheric Administration (NOAA) Flood Forecasting Centers located at Harrisburg, Pennsylvania, and Trenton, New Jersey.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. A flood event of a magnitude which is expected to be equaled or exceeded once on the average during any 100-year period (recurrence interval) has been selected as having special significance for floodplain management and for flood insurance rates. This event, commonly termed the 100-year flood, has a 1 percent chance of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Discharges for the Delaware River were obtained from the Flood Insurance Studies for the Town of Delaware and the Town of Fremont (References 1 and 2). Hydrologic analyses were carried out to establish the peak discharge-frequency and peak elevation-frequency relationships for each flooding source studied in detail affecting the community.

All USGS stream gages with a reasonable number of years of record in Monroe, Wayne, Pike, and nearby counties were analyzed. The methodology that is described in Bulletin 17B was used to develop 100-year flood discharges (Reference 3). A regional curve showing drainage area versus 100-year flood discharge was then generated using the results of the statistical analysis. Data from this curve were applied to Little Equinunk Creek and South Branch Equinunk Creek.

A summary of the drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 100-YEAR
DELAWARE RIVER		
At port Jervis, New York (USGS Gage No. 01454000)	3,076	170,000[1]
Near Barryville, New York (USGS Gage No. 01428500)	2,023	150,000[1]

[1]Regulated Annual Peak Discharge from the Delaware River Basin Commission, Hydrology Coordinating Committee

TABLE 1 - SUMMARY OF DISCHARGES (continued)

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 100-YEAR
LITTLE EQUINUNK CREEK		
At downstream study limit	24.9	3,490
SOUTH BRANCH EQUINUNK CREEK		
At downstream study limit	9.2	1,320
Downstream of Whitleys Road bridge	7.6	1,090

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the source studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Water-surface elevations for the Delaware River were obtained from the Flood Insurance Studies for the Town of Delaware and the Town of Fremont (References 2 and 3).

Water-surface elevations for Little Equinunk Creek and South Branch Equinunk Creek were computed through use of the COE HEC-2 step-backwater computer program (Reference 4).

Cross sections for the backwater analysis were photogrammetric and/or field surveyed and were located at close intervals above and below bridges and culverts in order to compute the significant backwater effects of these structures (Reference 5). The ground control for the photogrammetry was acquired using inertial surveying techniques (Reference 6).

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1) and the Flood Insurance Rate Map (Exhibit 2), where applicable.

Channel and overbank roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and were based on field observations of the stream and floodplain areas. For the Delaware River, the channel "n" values range from 0.033 to 0.036, and the overbank "n" values range from 0.040 to 0.120. Roughness values for Little Equinunk Creek and South Branch Equinunk Creek are 0.045 for the main channels and 0.090 for the overbank areas (Reference 7).

Flood profiles were drawn to an accuracy of 1.0 foot showing computed water-surface elevations for floods of the 100-year recurrence interval (Exhibit 1). The starting water-surface elevation for the Delaware River was obtained from the Flood Insurance Study for the Town of Cochecton (Reference 8). The starting water-surface

elevations for Little Equinunk Creek and the South Branch Equinunk Creek were obtained from backwater computations of their respective main stems or from normal depth computations, as appropriate. The results of the water-surface elevations are tabulated for selected cross sections (Table 2).

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3).

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100-year floodplain boundaries to assist communities in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. For the stream studied in detail, the 100-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24,000 with a contour interval of 20 feet (Reference 9).

For the flooding sources studied by approximate methods, the boundary of the 100-year flood was delineated using the Flood Hazard Boundary Map for the Township of Manchester (Reference 10).

The 100-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE). Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One

FLOODING SOURCE		STREAM CHANNEL			LEFT OVERBANK			RIGHT OVERBANK			100 YEAR FLOOD WATER SURFACE ELEVATION
CROSS SECTION	DISTANCE (FT.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	
A (1)	700	210	(2)	(2)	760	(2)	(2)	190	(2)	(2)	816.8
B	2600	50	3020	11.7	65	340	2.9	10	130	3.6	843.5
C	4450	90	3370	10.5	15	10	1.4	15	110	3.5	878.8
D	6420	50	3100	12.5	20	180	3.9	20	210	3.9	919.9

(1) Topwidth adjusted due to backwater from Delaware River.
(2) Data not available due to topwidth adjustment.

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF MANCHESTER, PA
(WAYNE CO.)

REGULATORY DATA

LITTLE EQUINUNK CREEK

FLOODING SOURCE		STREAM CHANNEL			LEFT OVERBANK			RIGHT OVERBANK			100 YEAR FLOOD WATER SURFACE ELEVATION (3)
CROSS SECTION	DISTANCE (FT)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	
A (1)	150	55	(2)	(2)	25	(2)	(2)	560	(2)	(2)	911.2
B	2300	30	850	7.8	225	390	1.8	70	80	1.7	944.3
C (1)	3200	35	(2)	(2)	5	(2)	(2)	260	(2)	(2)	958.6
D (1)	4440	25	(2)	(2)	15	(2)	(2)	360	(2)	(2)	978.0
E	5400	25	740	9.7	1	3	1.7	230	580	3.3	998.4
F	6210	25	780	8.4	210	490	2.2	10	50	2.8	1017.0
G	7450	30	1000	10.2	10	40	3.1	10	50	3.1	1041.9
H	9125	40	1090	9.6	0	0	0.0	0	0	0.0	1086.7
I	11500	45	980	7.4	125	110	2.7	10	10	1.3	1124.4

(1) Topwidth adjusted due to ineffective flow area.
(2) Data not available due to topwidth adjustment.
(3) Elevation computed without consideration of backwater from Equinunk Creek.

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF MANCHESTER, PA

(WAYNE CO.)

REGULATORY DATA

SOUTH BRANCH EQUINUNK CREEK

aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodway in this study is presented to local agencies as a minimum standard that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodway presented in this study was computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (Table 3). The computed floodway is shown on the Flood Insurance Rate Map (Exhibit 2). In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

No floodways were calculated as part of this study; the floodway for the Delaware River was obtained from the Flood Insurance Studies for the Towns of Delaware and Freemont, New York (References 2 and 3). Portions of the floodway widths for the Delaware River extend beyond the corporate limits.

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Delaware River								
A	500	699	13,374	9.1	773.3	773.3	773.4	0.1
B	1,436	640	12,223	10.0	774.1	774.1	774.1	0.0
C	2,432	501	9,775	12.5	774.9	774.9	775.0	0.1
D	3,544	600	12,741	9.6	777.2	777.2	777.2	0.0
E	4,564	552	11,603	10.5	778.1	778.1	778.1	0.0
F	5,548	563	11,884	10.3	779.1	779.1	779.3	0.2
G	6,544	460	10,284	11.9	780.1	780.1	780.2	0.1
H	7,704	492	10,285	11.9	781.7	781.7	781.9	0.2
I	8,552	546	11,918	10.2	783.3	783.3	783.5	0.2
J	9,444	516	10,077	12.1	784.2	784.2	784.3	0.1
K	10,516	498	10,749	11.4	786.2	786.2	786.2	0.0
L	11,508	799	15,244	8.0	787.8	787.8	788.2	0.4
M	12,568	817	15,379	7.9	788.6	788.6	789.0	0.4
N	13,640	629	11,828	10.3	789.3	789.3	789.7	0.4
O	14,702	668	12,160	10.0	790.4	790.4	791.0	0.6
P	15,742	515	9,906	12.3	791.6	791.6	792.2	0.6
Q	16,890	558	10,438	11.7	793.9	793.9	794.3	0.4
R	17,898	433	8,533	14.3	795.5	795.5	795.8	0.3
S	18,880	433	8,918	13.7	797.9	797.9	798.1	0.2
T	19,810	419	9,338	13.1	799.6	799.6	800.1	0.5
U	20,786	534	11,666	10.5	801.9	801.9	802.3	0.4
V	21,826	542	12,268	9.9	803.3	803.3	803.6	0.3
W	23,006	588	12,949	9.4	804.5	804.5	804.8	0.3
X	24,102	582	11,090	11.0	805.6	805.6	805.7	0.1
Y	25,158	562	12,241	9.8	806.5	806.5	807.3	0.8
Z	26,170	482	10,259	11.7	807.5	807.5	808.2	0.7

[1]Feet above corporate limits
[2]This width extends beyond corporate limits

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF MANCHESTER, PA

(WAYNE CO.)

FLOODWAY DATA

DELAWARE RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Delaware River (continued)								
AA	27,218	851	17,798	6.7	809.8	809.8	810.5	0.7
AB	28,250	740	15,243	7.9	810.3	810.3	811.0	0.7
AC	29,302	565	11,553	10.4	811.0	811.0	811.6	0.6
AD	30,078	447	9,843	12.2	811.7	811.7	812.3	0.6
AE	30,918	376	8,235	14.6	812.8	812.8	813.3	0.5
AF	32,007	483	11,813	10.2	816.1	816.1	816.3	0.2
AG	32,414	483	10,066	11.9	816.7	816.7	816.8	0.1
AH	33,366	551	11,826	9.8	818.6	818.6	818.7	0.1
AI	34,454	652	12,865	9.0	819.7	819.7	820.0	0.3
AJ	35,470	534	10,934	10.6	820.5	820.5	820.8	0.3
AK	36,462	597	12,068	9.6	822.0	822.0	822.2	0.2
AL	37,462	664	12,360	9.4	823.1	823.1	823.3	0.2
AM	38,438	596	10,621	10.9	824.1	824.1	824.3	0.2
AN	39,402	545	10,129	11.5	825.4	825.4	825.6	0.2
AO	40,506	449	10,011	11.4	826.9	826.9	827.2	0.3
AP	41,674	567	12,425	9.2	828.8	828.8	829.1	0.3
AQ	42,710	446	9,234	12.4	829.6	829.6	829.7	0.1
AR	43,734	471	9,606	11.9	831.3	831.3	831.5	0.2
AS	44,738	673	13,747	8.3	833.3	833.3	834.0	0.7
AT	45,786	533	10,465	10.9	834.3	834.3	835.1	0.8
AU	46,590	503	9,525	12.0	835.3	835.3	836.0	0.7
AV	47,310	556	10,752	10.6	837.1	837.1	837.8	0.7
AW	48,270	589	14,732	7.6	839.7	839.7	840.3	0.6
AX	49,126	398	10,547	10.6	839.9	839.9	840.4	0.5

[1]Feet above corporate limits
[2]This width extends beyond corporate limits

TABLE 3

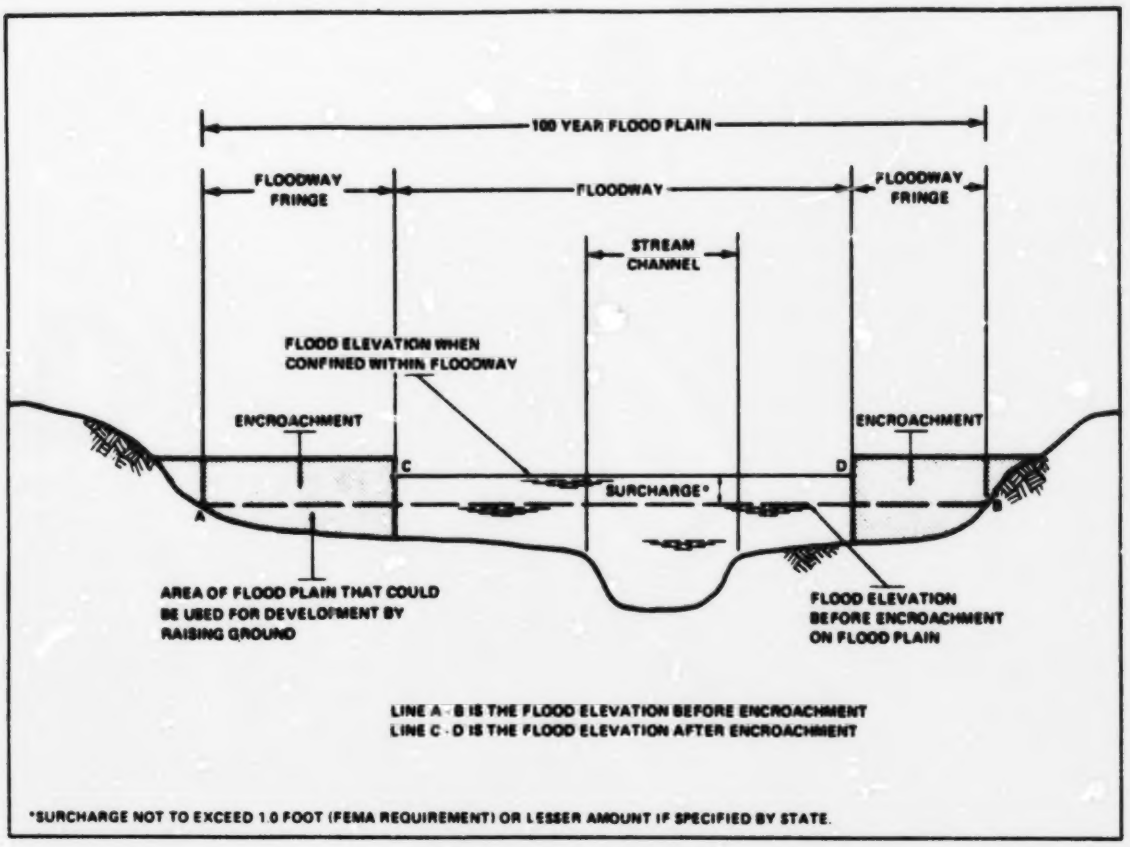
FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF MANCHESTER, PA

(WAYNE CO.)

FLOODWAY DATA

DELAWARE RIVER


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC FIGURE 2

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 100-year floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, and to areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100-year floodplain. The locations of selected cross sections used in the hydraulic analyses are shown where applicable.

7.0 OTHER STUDIES

Flood Insurance Studies have been prepared for the Towns of Delaware and Freemont, New York; and the Township of Buckingham, Pennsylvania (References 1, 2, and 11). The results of this study are in complete agreement with the results of those studies.

Due to its more detailed nature, this study supersedes the Flood Hazard Boundary Map for the Township of Manchester (Reference 10).

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting FEMA, the Natural and Technological Hazards Division, Liberty Square Building (Second Floor), 105 South Seventh Street, Philadelphia, Pennsylvania 19106.

9.0 BIBLIOGRAPHY AND REFERENCES

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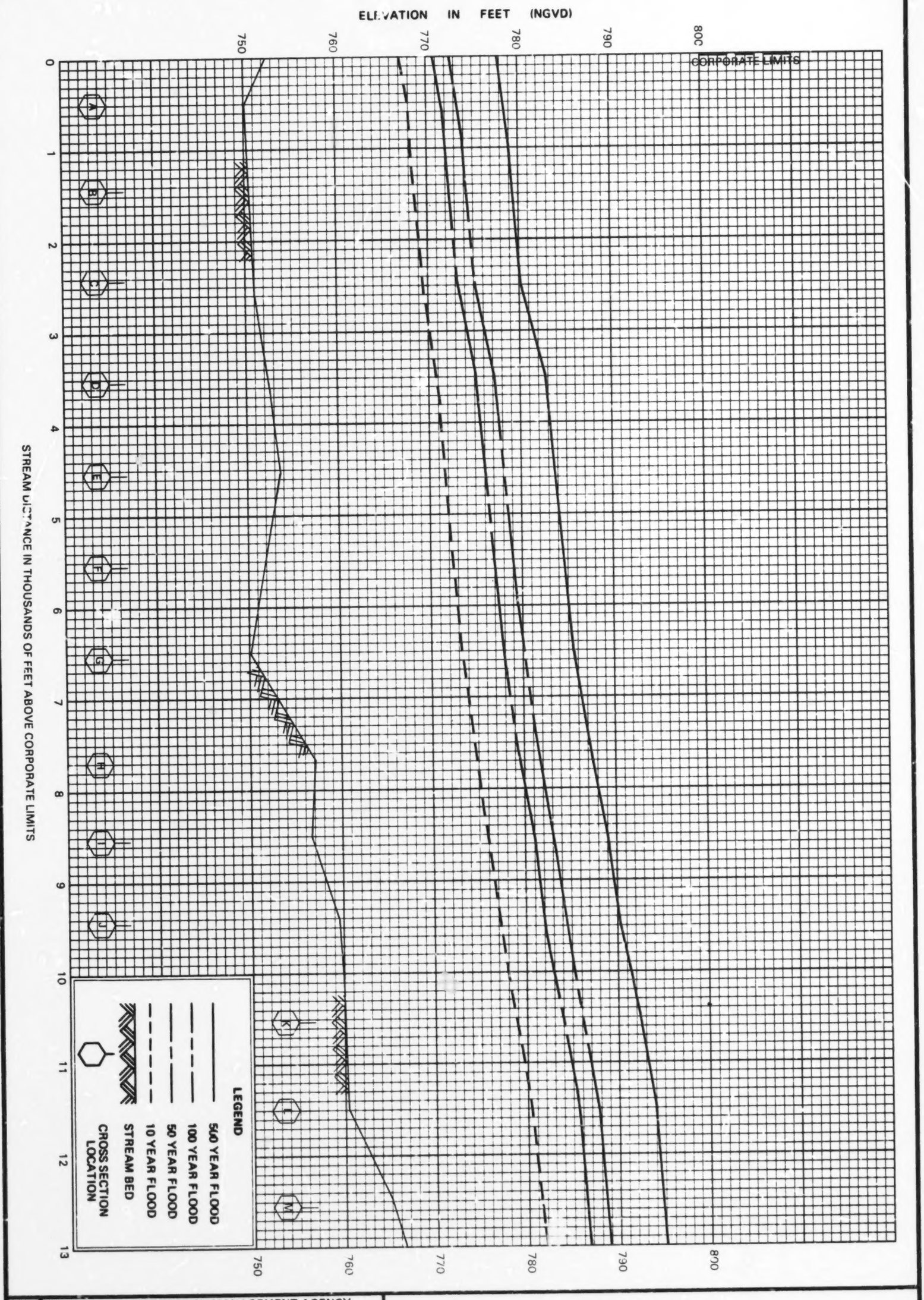
10. U. S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, Township of Manchester, Wayne County, Pennsylvania, Washington, D.C., November 29, 1974.

11. Federal Emergency Management Agency, Flood Insurance Study, Township of Buckingham, Wayne County, Pennsylvania, Washington, D.C., August 19, 1985.

EXHIBIT 3 - ELEVATION REFERENCE MARKS

Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 1	20	835.33	Stalker Road bridge over Little Equinunk Creek. Square cut in top of downstream bridge wall in steel girder at northeast abutment.
RM 2	15	989.30	Equinunk Road bridge over South Branch Equinunk Creek. Square cut in top of downstream concrete curbing at west abutment.
RM 3	15	1031.16	Whitleys Road bridge over South Branch Equinunk Creek. P.K. nail in top of downstream timber deck at north abutment.
RM 4	15	1139.45	S.R. 1018 bridge over South Branch Equinunk Creek. Square cut in top of downstream headwall over center of arch.



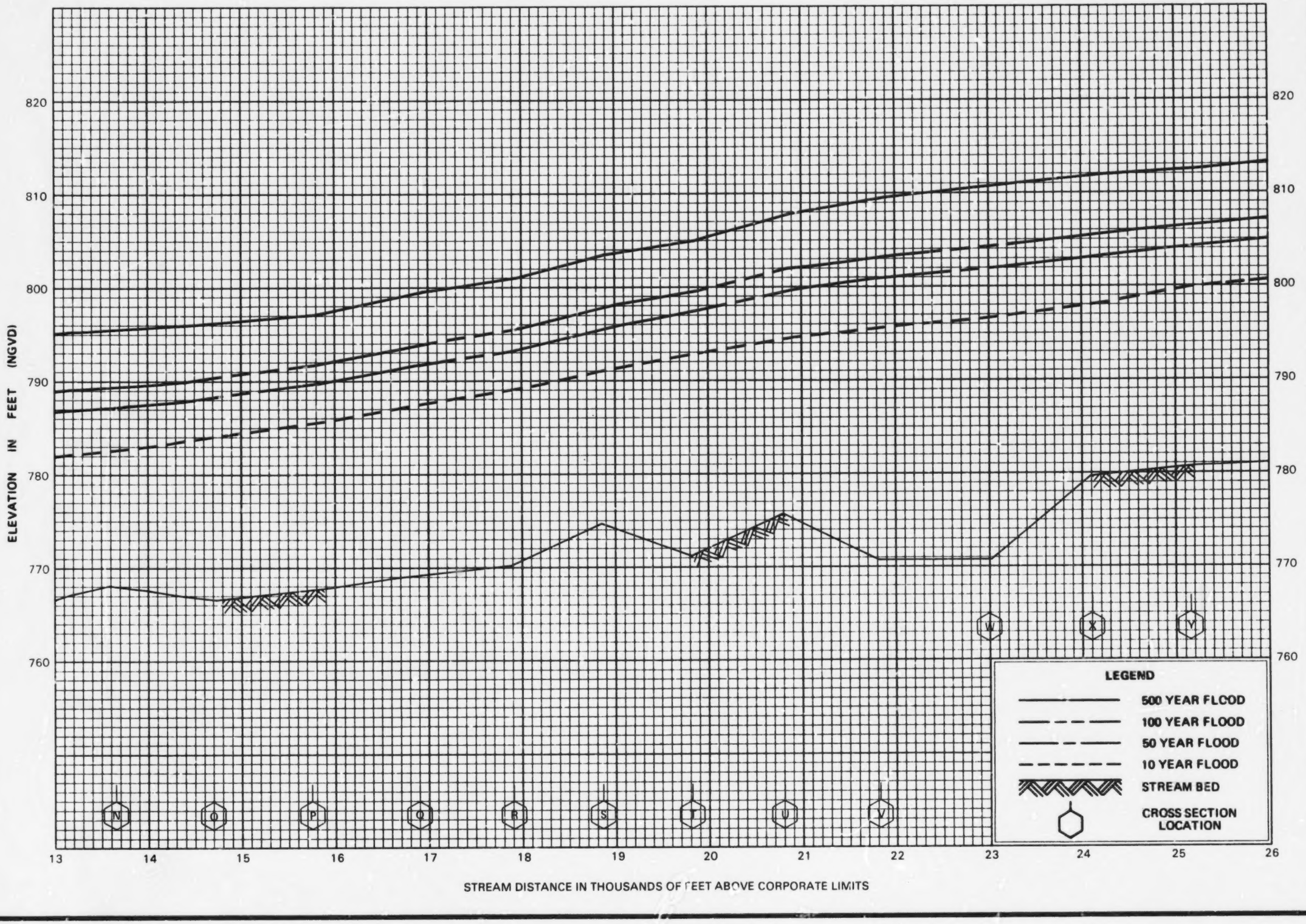
FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF MANCHESTER, PA
(WAYNE CO.)

FLOOD PROFILES

DELAWARE RIVER

01P



FLOOD PROFILES

DELAWARE RIVER

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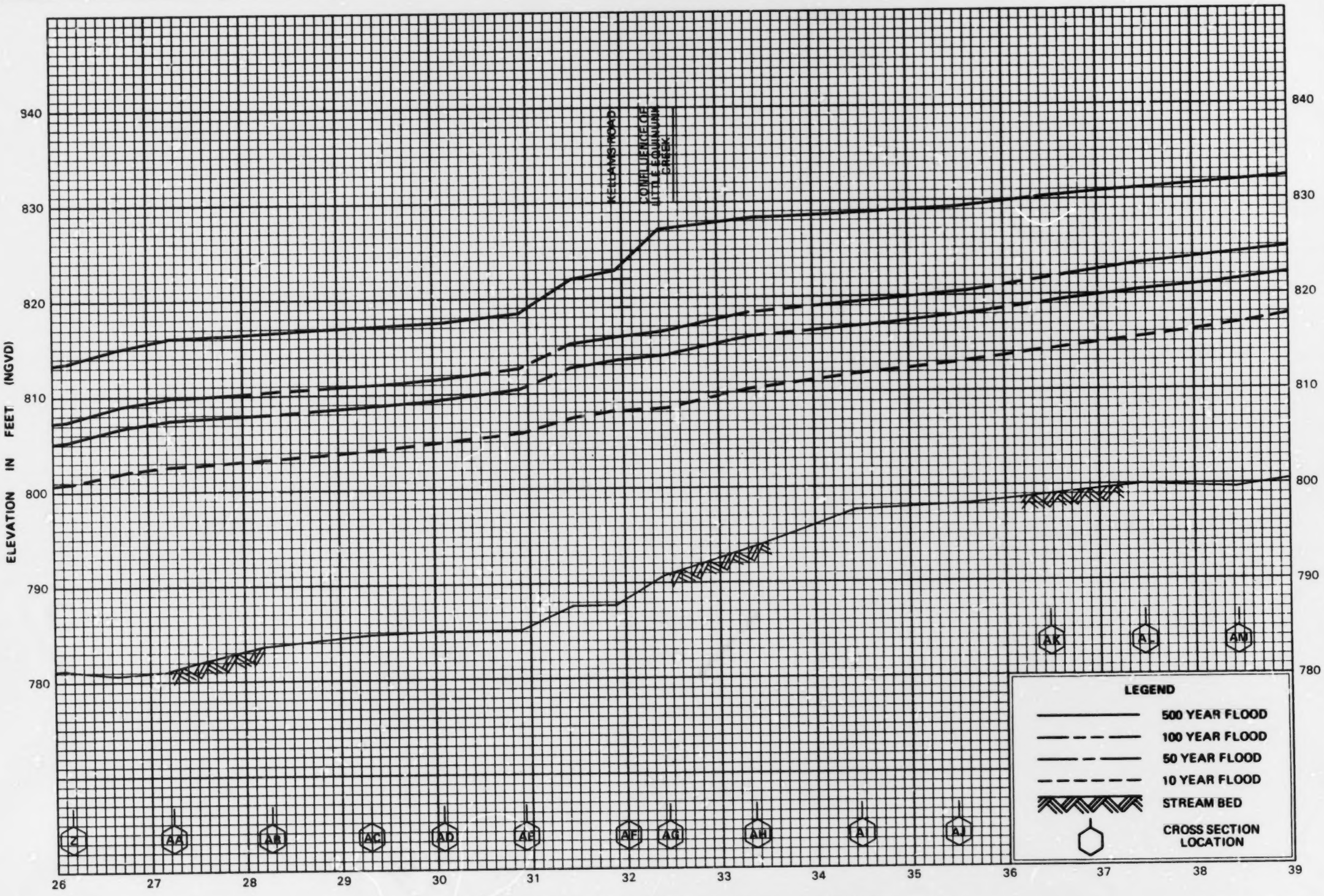
(WAYNE CO.)

02P



FLOOD PROFILES

DELAWARE RIVER

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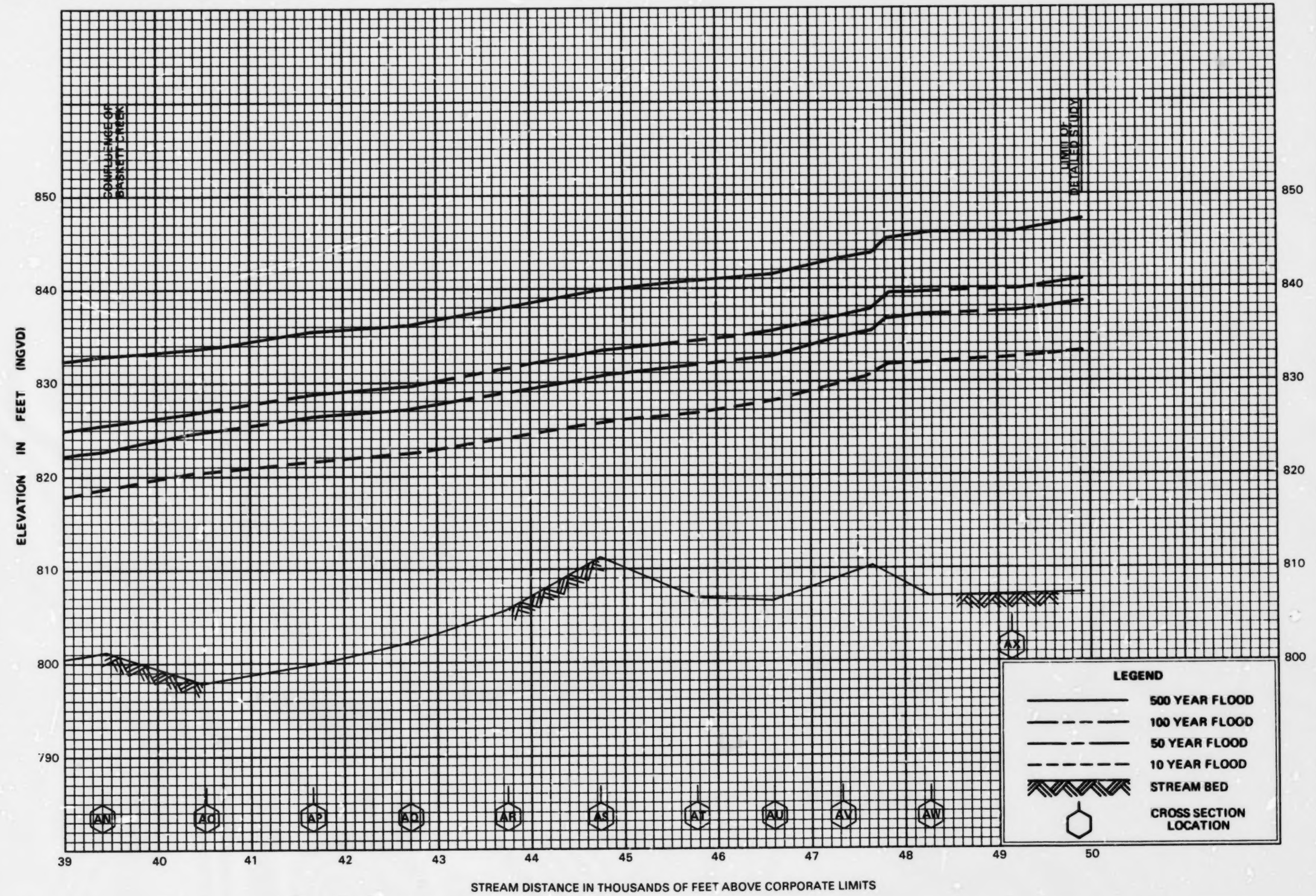
(WAYNE CO.)

03P



FLOOD PROFILES

DELAWARE RIVER

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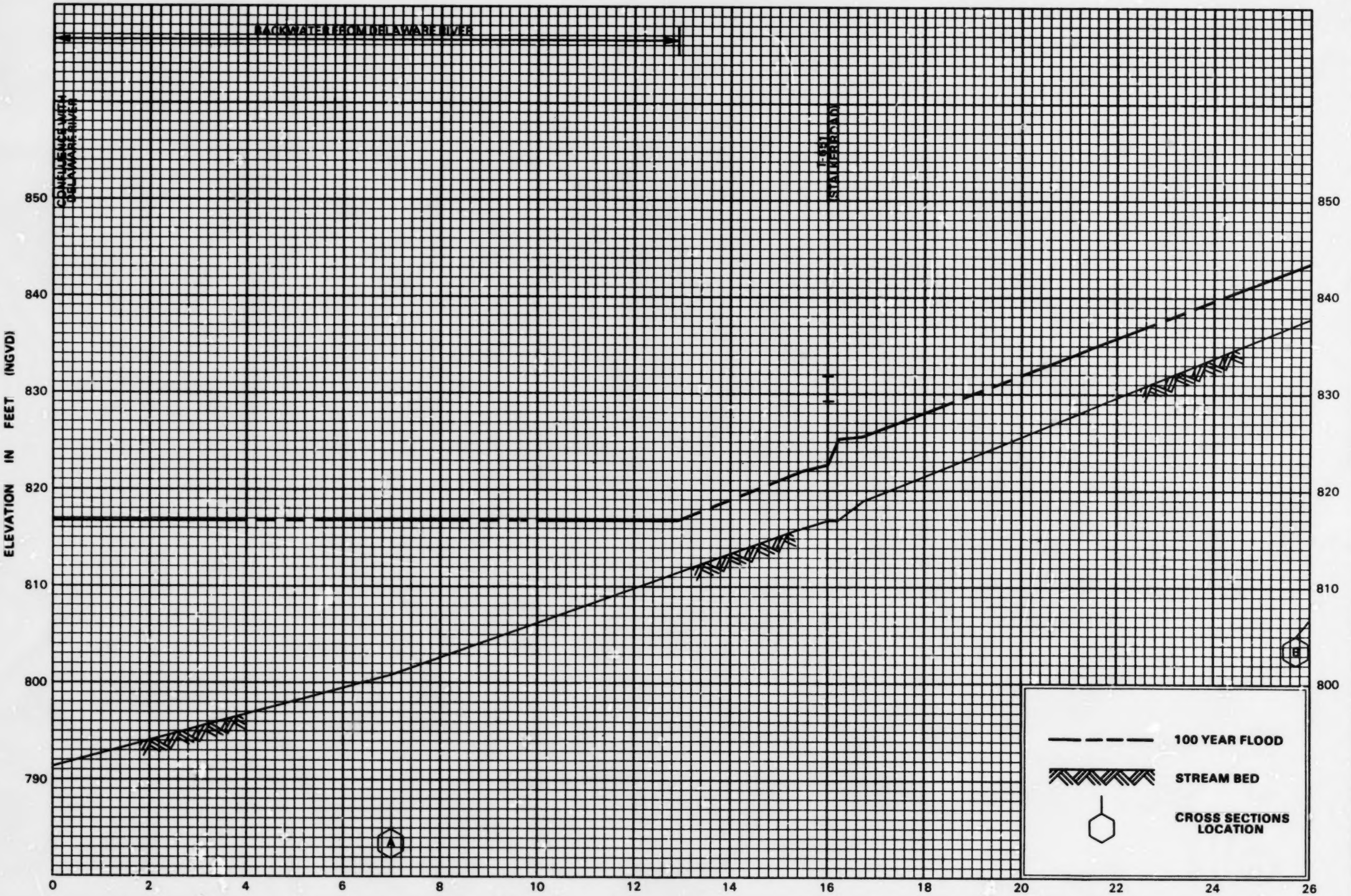
04P



FLOOD PROFILES

LITTLE EQUINUNK CREEK

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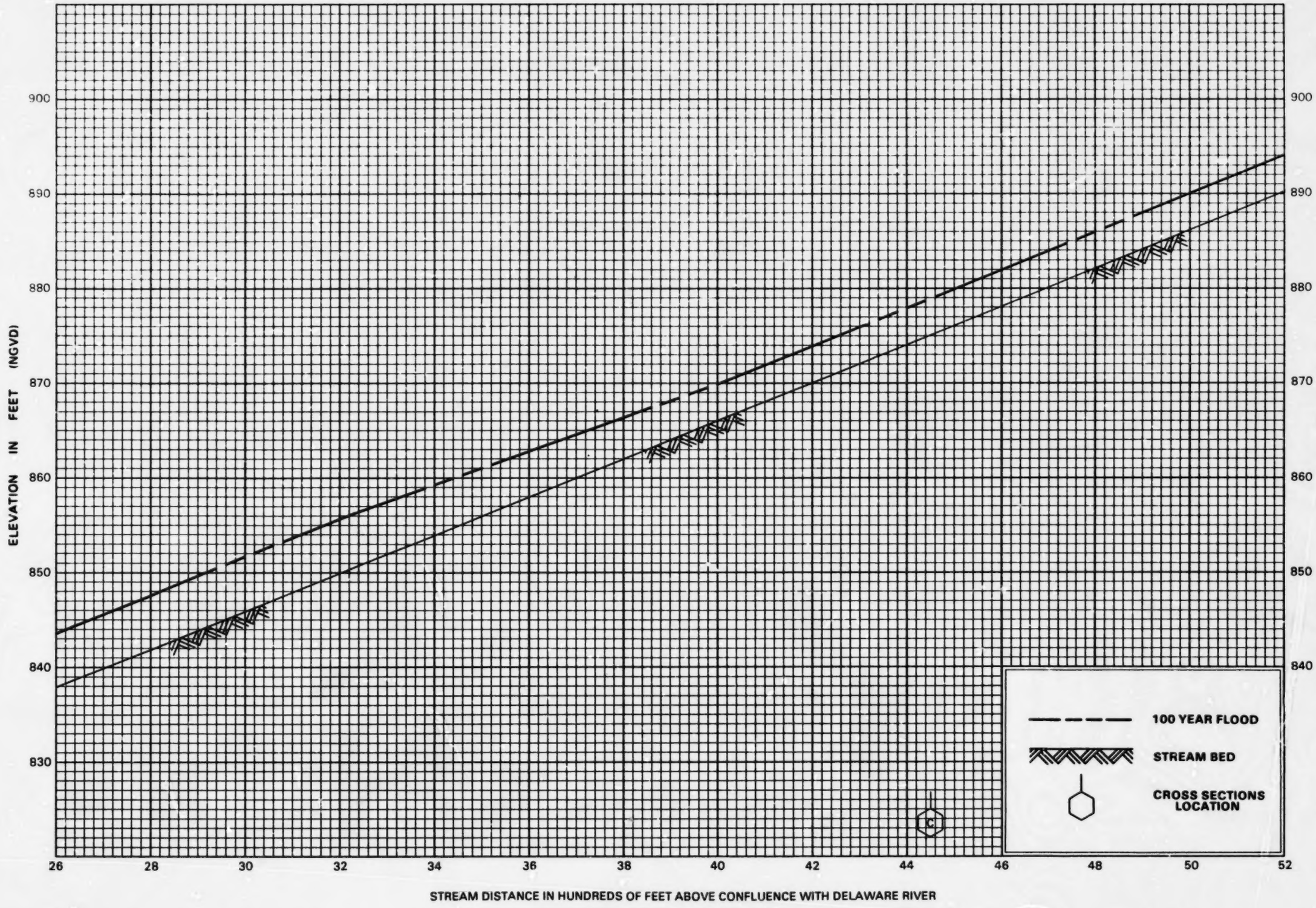
TOWNSHIP OF MANCHESTER, PA
(WAYNE CO.)

05P



FLOOD PROFILES

LITTLE EQUINUNK CREEK

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TOWNSHIP OF MANCHESTER, PA
(WAYNE CO.)

06P

ELEVATION IN FEET (NGVD)

890 900 910 920

52 54 56 58 60 62 64 66

STREAM DISTANCE IN HUNDREDS OF FEET ABOVE CONFLUENCE WITH DELAWARE RIVER

LIMIT OF DETAILED STUDY

100 YEAR FLOOD

STREAM BED

CROSS SECTIONS LOCATION

890 900 910 920

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF MANCHESTER, PA
(WAYNE CO.)

FLOOD PROFILES

LITTLE EQUINUNK CREEK

07P

24

ELEVATION IN FEET (NGVD)

900 910 920 930 940 950

0 2 4 6 8 10 12 14 16 18 20 22 24 26

STREAM DISTANCE IN HUNDREDS OF FEET ABOVE CONFLUENCE WITH EQUINUNK CREEK

LIMIT OF DETAILED STUDY

A

65

100 YEAR FLOOD

STREAM BED

CROSS SECTIONS LOCATION

910 920 930 940 950

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TOWNSHIP OF MANCHESTER, PA

(WAYNE CO.)

08P

FLOOD PROFILES

SOUTH BRANCH EQUINUNK CREEK

35

ELEVATION IN FEET (NGVD)

940 950 960 970 980 990 1000

26 28 30 32 34 36 38 40 42 44 46 48 50 52

STREAM DISTANCE IN HUNDREDS OF FEET ABOVE CONFLUENCE WITH EQUINUNK CREEK

950 960 970 980 990 1000

G

D

100 YEAR FLOOD

STREAM BED

CROSS SECTIONS LOCATION

SR 1023 (EQUINUNK ROAD)

FEDERAL EMERGENCY MANAGEMENT AGENCY

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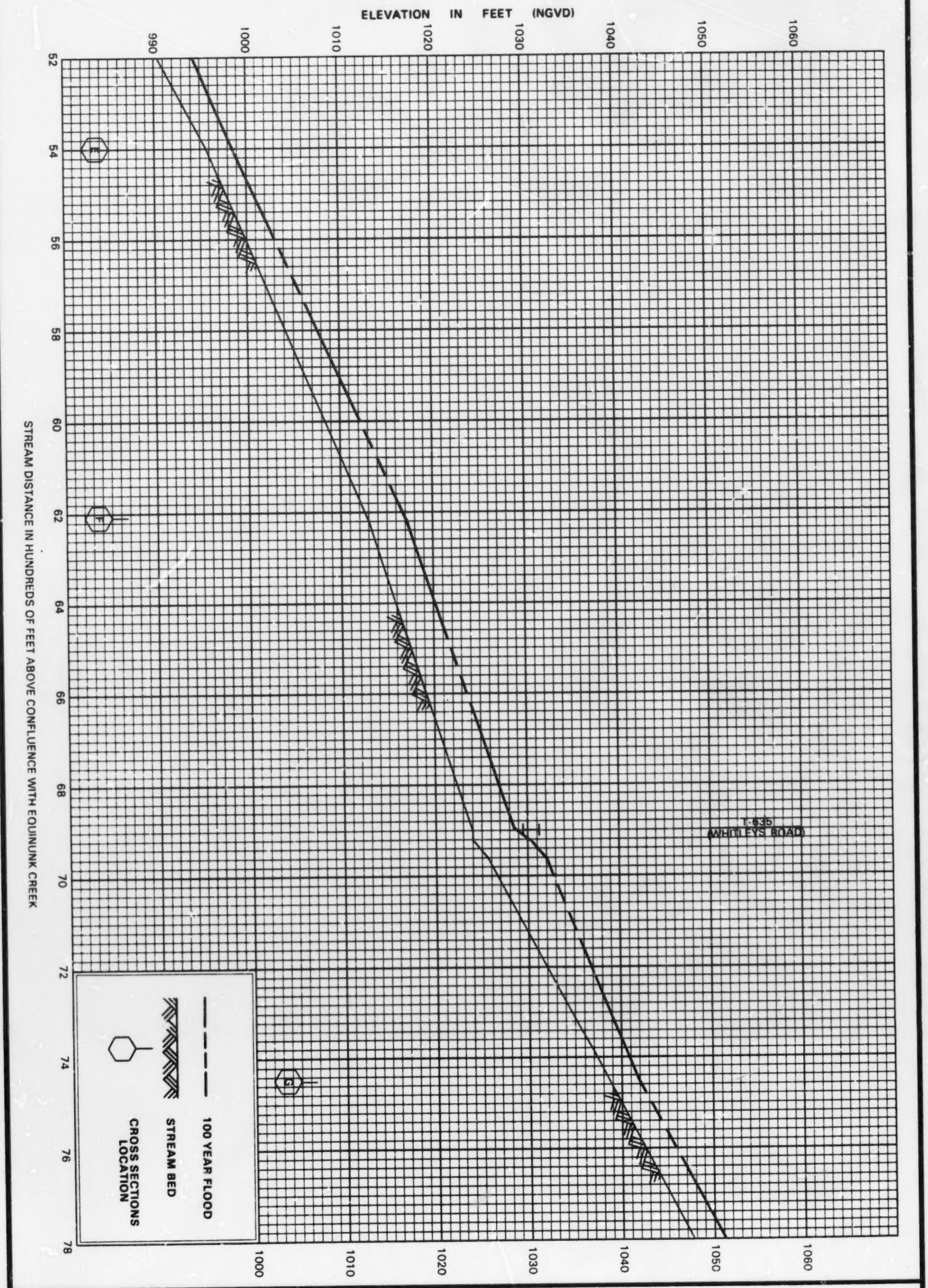
(WAYNE CO.)

FLOOD PROFILES

SOUTH BRANCH EQUINUNK CREEK

09P

26



10P

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(WAYNE CO.)

FLOOD PROFILES

SOUTH BRANCH EQUINUNK CREEK

ELEVATION IN FEET (NGVD)

1040 1050 1060 1070 1080 1090 1100 1110

78 80 82 84 86 88 90 92 94 96 98 100 102 104

STREAM DISTANCE IN HUNDREDS OF FEET ABOVE CONFLUENCE WITH EQUINUNK CREEK

H

100 YEAR FLOOD

STREAM BED

CROSS SECTIONS LOCATION

1050 1060 1070 1080 1090 1100 1110

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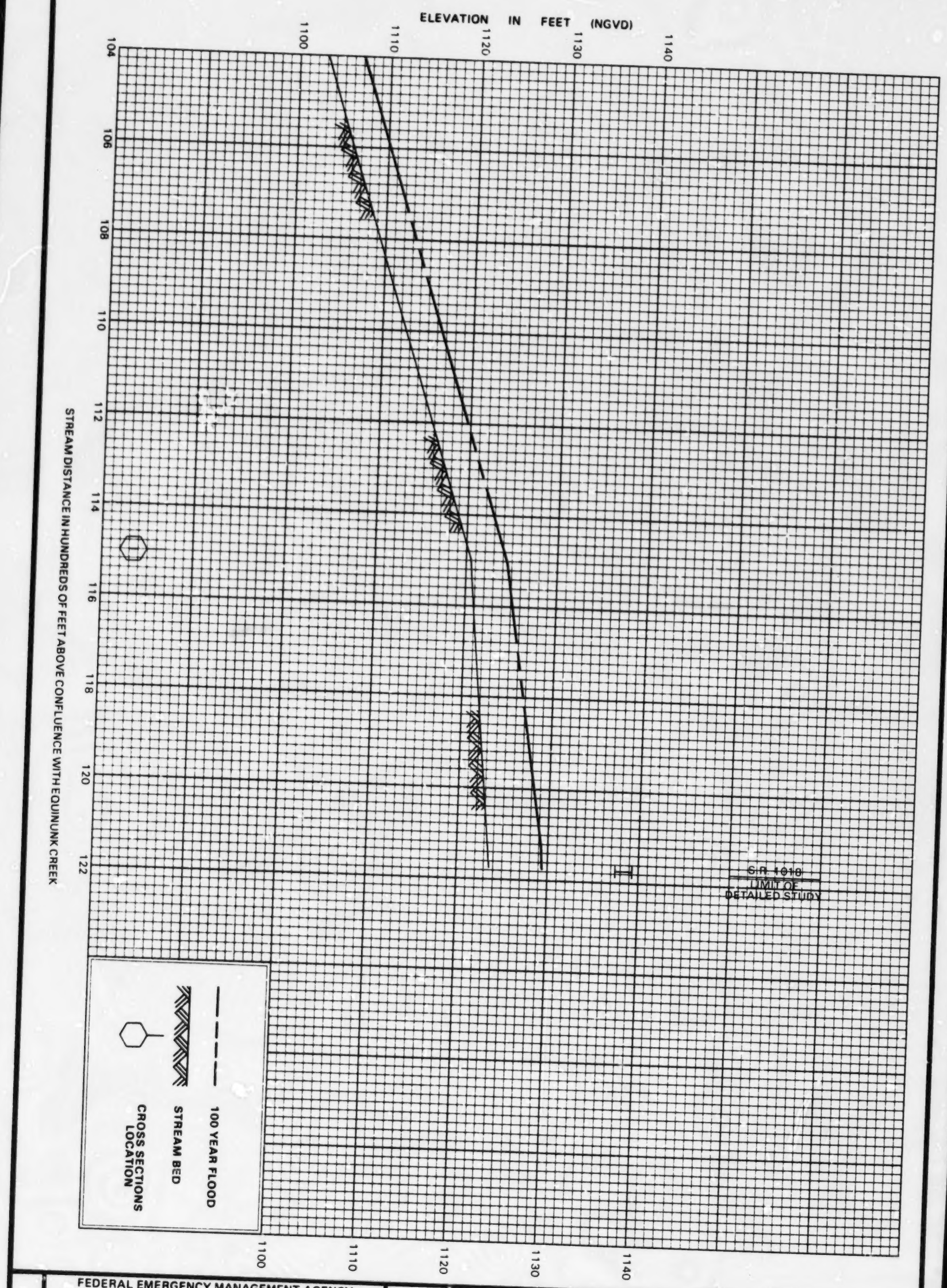
(WAYNE CO.)

11P

FLOOD PROFILES

SOUTH BRANCH EQUINUNK CREEK



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(WAYNE CO.)

FLOOD PROFILES

SOUTH BRANCH EQUINUNK CREEK

12P